

SECTION 0.0 STREAMLINED RISK ASSESSMENT

Section 0.1 Introduction

This Engineering Evaluation and Cost Analysis (EECA) proposes certain response actions to address mine waste contamination that is found at various locations along the Union Pacific Railroad (UPRR) Wallace-Mullan Branch right-of-way (ROW) located in northern Idaho. The ROW extends 72 miles through a variety of residential, industrial, and remote settings. Contamination by mineral industry wastes from ROW and non- ROW sources is prevalent throughout the basin and portions of the ROW. This contamination is the result of mine wastes used as ballast for the UPRR rail line, spills of some concentrate materials, and the transport and fluvial deposition of mine tailings by the river system that runs adjacent to much of the ROW.

The UPRR is in the process of abandoning the Wallace-Mullan Branch and converting the ROW to a recreational trail. Much of the ROW is currently used by local residents. Conversion to a trail operated by a coordinated managing entity will provide an attractive recreational asset and allow for control and monitoring of ROW use. These controls can also be an effective means of managing risks from exposures that may occur in recreational and residential areas in and adjacent to the ROW.

EECA Risk Assessment: This streamlined risk assessment addresses the incremental human health risk associated with heavy metal contamination found at various locations on the ROW. This risk assessment evaluates the potential for human health risk based on the contemplated future use of the ROW as a rural recreational trail from Mullan to Plummer, Idaho. A streamlined risk assessment for an Engineering Evaluation and Cost Analysis (EECA) differs from the comprehensive human health risk assessment typically conducted with a Remedial Investigation and Feasibility Study (RI/FS). The EECA assessment is not comprehensive and does not address all potential contaminants and pathways. Potential health risks from cumulative site-related exposures usually evaluated in an RI/FS are not completely assessed in an EECA. The quantitative analyses presented herein are limited to the removal action and evaluation of the reduction in exposures and of risk associated with subsequent use of the ROW.

Methodology: The methodology for this streamlined evaluation is similar to that employed at the Bunker Hill Superfund Site (BHSS) included in *Human Health Risk Assessment Protocol for the Populated Areas of the Bunker Hill Superfund Site* (Jacobs Engineering Group, Inc., et al., 1989), *Risk Assessment and Data Evaluation Report (RADER)* (TerraGraphics, 1990), *Human Health Risk Assessment for the Non-populated Areas of the Bunker Hill NPL Site* (SAIC, 1992), and *Risk Assessment Guidance for Superfund: Human Health Evaluation Manual Part A* (EPA, 1989). The approach utilized within this streamlined assessment is termed an assessment of *incremental* risk and refers only to those behaviors and activities that result in exposure to soils and dusts on the ROW properties. In a comprehensive risk assessment these incremental risks would be considered as adding to baseline risks. The analyses utilizing the methods employed at the BHSS are performed to provide a comparison to the approach used and risk management

strategies employed at the BHSS. The USEPA and the State of Idaho are currently performing the Bunker Hill Basin-wide RI/FS to comprehensively investigate areas where hazardous substances have come to be located throughout the Coeur d'Alene Basin. As part of that RI/FS, a more comprehensive risk assessment will be performed.

This assessment also analyzes risk utilizing *Recommendations of the Technical Review Workgroup for Lead for an Interim Approach to Assessing Risks Associated with Adult Exposures to Lead in Soil* (Interim Approach) (EPA, 1996) and current recommendations from USEPA Region X risk assessment personnel. These evaluations are provided for comparison with more recent guidance and typical procedures employed in similar risk assessments.

The UPRR ROW is a single continuous strip of land that, once converted to a trail, would be used by residents and visitors for activities such as biking, walking, running, horseback riding, etc. The assessment is limited to subsequent usage of the proposed trail. Other activities and exposures that may occur off trail (i.e., camping, swimming, fishing, etc.) are not assessed within this EECA risk assessment. The soil ingestion exposure route to the contaminants of concern (arsenic, cadmium, zinc, and lead) for three scenarios (residential, child and adult recreational, and adult occupational) is the primary exposure route addressed. Comparative calculations for dermal and inhalation routes are provided for risk managers' consideration. Figure 1 represents a conceptual model of this EECA streamlined risk assessment. The assessment does not address other contaminants of concern, other exposure routes, or exposures beyond the ROW that individuals using the trail might experience. Only incremental exposures associated with these specific activities are evaluated. As previously noted, a more comprehensive risk assessment will be conducted as part of the Bunker Hill Basin-wide RI/FS.

Exposure Scenarios: This human health risk assessment analyzes exposures to contaminants from the ROW that may occur in residential, recreational, and occupational exposure scenarios. In analyzing residential exposures, this assessment examines the ROW or trail-specific portion of local residents' soil and dust contact that may occur in everyday or typical activities. The evaluation does not consider other, non-ROW exposures that may occur in the typical residential environment nor does it examine conversion of ROW properties to residential uses. Pregnant women and pre-school children are the populations of greatest concern in the residential scenario. Specific risk indices are not developed for the residential scenarios. Pre-removal metals concentrations in the residential portions of the ROW are extremely high and beyond the practical limits of blood lead projection models. However, the response action under consideration will include a comprehensive response to contamination within the residential portions of the ROW. Risks are evaluated by comparison of pre- and post-removal soil and dust concentrations to the BHSS and other site cleanup criteria.

In analyzing the recreational exposure scenario, the assessment examines risks for 2 groups, 6 to 15 year old children and adults. Children under six years of age are not addressed in the recreational exposure evaluations. At the BHSS, any developed recreational areas specified for pre-school children were required to meet the more stringent residential area cleanup criteria. The same assumption applies to this assessment. Specific recreational areas where significant use

by pre-school children is anticipated will receive the same comprehensive response that is contemplated for residential areas. Accordingly, these areas are evaluated using the same, more stringent criteria that are used under the residential scenario. Recreational scenario risk calculations performed for 6-15 year old children and adults consider only seasonal on-trail activities and exposure to contaminants. These exposures are compared in a pre- and post-removal context, assuming that the same frequency and duration of exposure will occur in either scenario. Total risks associated with other potential exposures, including those that may result from use of the trail to access adjacent contaminated media are not evaluated. As a result, this assessment should be viewed only as an evaluation of the EE/CA response actions and not as an assessment of the overall exposures to contaminants that could be experienced by either local residents or visitors to the area.

Four subsets of exposure parameters are considered under the recreational scenarios. These parameters estimate conditions under which an exposure to contaminants may occur on the ROW. Table 1 lists the assumptions and parameters used for intake calculations for the four subsets of exposure potential. The first subset consists of the parameters used in the BHSS Non-populated Areas risk assessment. These parameters were developed to assess casual recreational access to undeveloped areas of the BHSS. The second subset is the Modified Trail scenario that assumes increased frequency of exposure by recreational users, and increased contaminant bioavailability and dose-response rates for lead. The Modified Trail parameters: i) reflect increases in the time that recreational users will have contact with contaminants when using a developed recreational facility (as opposed to the casual visits to undeveloped areas used in the BHSS assessment); and ii) reflect the range of absorption parameters that could apply. The third subset includes the application of the USEPA Adult Model for lead using recommended default parameters. The fourth subset, the Reasonable Maximum Exposure (RME) scenario, increases exposure frequency and soil ingestion rates to levels recommended by Region X EPA guidance.

Occupational exposures to contaminants are analyzed for adult trail workers and assume full-time year round employment in trail-related activities. The occupational analyses are also conducted for the same four subsets of exposure parameters (BHSS, Modified Trail, EPA Adult Model and RME). However, evaluation of the post-removal conditions notes that workers may continue to contact contaminated materials in the course of maintenance and repair activities that are unavailable to recreational users.

The USEPA Adult Model and RME scenarios specifically assume the amount of soil and dust ingested while on the trail. The BHSS and Modified Trail Scenarios ingestion rates are developed as a time weighted average of the typical total daily soil and dust ingestion rate. These basic scenarios should provide a range in the assessment of typical soil-based exposures and associated risks that might occur with the development of the trail. Uncertainty associated with the analyses can be addressed by discussing the sensitivity of risk estimates to these parameters.

Pre- and Post- Action Conditions: The scenarios are each evaluated with No-action and projected post-response action soil concentrations. The No-action alternative reflects conditions as if the rail-line were abandoned as is and used for a trail with the same frequency as that

expected in the conversion. The No-action scenarios use the same exposure, and inherent use and activity times as the post-response action alternative that assumes the response action has been performed and the trail is in place. It is not expected that such use rates and contact times are ongoing currently, as railroad infrastructure and the generally undesirable conditions in the ROW today discourage the anticipated level of public access. Post-response action conditions assume that combinations of the candidate response actions evaluated in the EECA will have been implemented and result in prescribed soil and dust concentrations in particular segments of the trail and access limitations in others.

Summary: The physical response actions (i.e., removals of contaminants and installation of protective barriers) described in the EECA, that are to be implemented in the designated residential areas that the UPRR ROW passes through, will resolve human health related concerns due to hazardous substances located on the ROW in these residential areas. However, risks relating to exposures to contaminants in residential areas off of the ROW may remain after implementation of the response action, as these actions are limited to the ROW. As previously stated, EPA and the State of Idaho are currently performing the Bunker Hill Basin-wide RI/FS that addresses contaminants found off of the ROW and will propose response actions as needed to address such contaminants.

In certain remote, non-residential, segments of the ROW, human health risks under the occupational and recreational scenarios are not resolved in their entirety by the implementation of physical response actions described in the EECA (i.e., removal of contaminants and installation of protective barriers). These remaining risks will be addressed by the institutional controls, described in this EECA, that are designed to limit exposure to contaminants. The use of these institutional control-type response actions is discussed in Section 0.7 of this report as a component of a recommended risk management strategy.

The recommended risk management strategy addresses occupational exposures through training and workplace safeguards; and remote area recreational exposures through trail amenities that promote visitation of prescribed clean areas or oases, and discourage contact with contaminated areas through education, signage, and access restrictions. Successful implementation of the institutional control response actions described in the EECA and the recommended risk management strategy should provide a reasonable margin of safety with regard to heavy metals exposures associated with the ROW that may remain after implementation of physical response actions.

Section 0.2 Contaminants of Concern

For this EECA Risk Assessment, contaminants of concern are limited to lead, zinc, cadmium, and arsenic. Other contaminants of toxicologic or environmental significance may be present on the properties to be included in the transfer, but have not yet been identified and are not considered in this assessment. Additional metals potentially associated with mine waste or railroad properties could include mercury, antimony, and copper, which were identified as contaminants of concern at the BHSS. Investigation of other railroad facilities in northern Idaho and eastern Washington

have indicated existence of contaminants other than heavy metals. No sampling has been done to characterize any of these potential contaminants in the basin.

A brief toxicological summary of each of the four contaminants of concern addressed in this EECA can be found in *Human Health Risk Assessment Protocol for the Populated Areas of the Bunker Hill Superfund Site* (Jacobs Engineering Group, Inc., et al., 1989).

Section 0.3 Sensitive Sub-populations

Selection of sensitive populations for exposure and risk assessment depends on a number of factors, including contaminant toxicity, sub-population pre-disposition to adverse health effects, projected land uses and activities, and behavioral patterns.

With respect to lead toxicity, pregnant women and pre-school children are typically the segment of the population at greatest risk for experiencing adverse health effects due to environmental exposures. These groups are of greatest concern in residential scenarios. Pre-school children are generally most at risk due to physiological, behavioral, and developmental considerations (young children have smaller bodies, consume more dirt, and are more likely to suffer central nervous system (CNS) damage). For the purposes of this assessment, pre-school children are defined as children less than 84 months of age (i.e., up to 7 years old).

Older children are the critical concern for recreational exposures in this assessment, because they are more likely to range beyond residential and developed trail rest areas and to engage in trail-specific activities that would bring them into contact with contaminants in the local soils. Pregnant women, considered a surrogate for the developing fetus, are usually of less concern in recreational settings, due to low soil and dust intake rates. This is true only if no dietary intake route is involved (e.g., gardening, fish or wild-produce) and if the woman does not engage in high-risk behavior that results in excessive soil contact rates (e.g., dirt biking or gardening). However, pregnant women are an important concern to address as part of the occupational exposure scenario because of their potential for exposure associated with trail maintenance and management activities.

Each of these sub-populations, including pre-school children, women of reproductive age in occupational settings, and older children, was considered in risk assessments conducted for the Bunker Hill Superfund Site (BHSS) (SAIC, 1992). Children 6 to 15 years of age were identified as the population most at risk (specifically 6 year old children) in recreational scenarios. This age group was selected because these children remain at substantial risk for CNS developmental damage; their normal and incidental behavior patterns include ingesting large amounts of soil; and they are beginning to range into unsupervised recreational play areas, often in the company of older siblings. Exposures to children less than 84 months of age were evaluated against criteria for health-protective residential soil lead concentrations because such children should not be exposed to lead concentrations outside their residence/daycare that exceed health-protective residential/daycare criteria. A similar approach is adopted for this assessment.

Section 0.4 Site Characterization/Contact Point Concentrations

The proposed trail is approximately seventy-two miles long. Much of the trail passes through remote areas paralleling a free-flowing river and crossing several wetlands and natural areas. Contamination by mine tailings and other mine waste from non-ROW sources are prevalent throughout the Basin. At some locations the trail is two to three miles from the nearest roadway access point. In several areas the trail passes through commercial and residential communities previously served by the railroad. As a result, there are several use scenarios and differing environmental media and contaminant concentrations to consider in performing risk assessment evaluations for the proposed response action.

These evaluations can be facilitated by segmenting the trail for characterization and by developing exposure scenarios for the segments. For EECA purposes the proposed trail is divided into three main segments: i) the Silver Valley east and upstream of the BHSS, ii) the Lower Basin, extending from the BHSS to Harrison, and iii) the Coeur d'Alene Indian Reservation from Harrison to near Plummer. These main sections are further divided into thirteen distinct sub-sections for contaminant concentration and risk scenario characterization. The BHSS is excluded from the EECA analysis.

Tables 2 through 4 summarize current land uses, resident populations, lead absorption, degree and extent of soil lead contamination in ROW segments, the proposed response action, and projected post-response action soil lead contamination levels. In Table 2, each segment is characterized by its primary land use and exposure potential. The proposed response action anticipates complete removal of contaminants or capping of the ROW with protective barriers in designated residential areas. The residential area response actions will extend for 1000 lineal feet beyond the outermost residence within a given residential area. (As used throughout this Risk Assessment, the term "barriers" or "protective barriers" refers to vegetated soil, gravel, asphalt or other clean, durable materials placed as a cap over potentially contaminated soil and other materials.) Post-response action contaminant concentrations in these areas are expected to be lower than the clean soil criteria established for the BHSS. Additional lead exposures and community average blood lead levels from the Coeur d'Alene Basin Study are shown in Tables 3a and 3b, respectively, for the purpose of establishing current conditions, as well as for comparison with ROW lead concentrations.

Section 0.4.1 Segment Concentration Calculations

Tables 4a-h provide estimated pre- and post-response action concentrations for lead, arsenic, cadmium and zinc. Contaminant concentration data from 1996 ROW sampling were grouped according to sampling milepost location for each of the segments discussed above, as indicated in Table 2. At each mile post location, a sample was collected at the center of the railroad, north and south of the railroad, and at a siding if one was present. Samples were collected at three depths for each location; 0 - 0.5 foot, 0.5 - 1 foot, and 1 - 1.5 feet. Averages, ranges, and standard deviations were calculated for each segment of the trail using the three depths for all samples within that segment. Averages for the top 1.5 feet depth of soils are shown in Tables 4a-

d. Tables 4e-h present averages for segments using only the top 6 inch depths. Generally, metals concentrations were comparable or higher at the greater depths (0.5-1 and 1-1.5 feet) than the top six inches. For these analyses, average values for the top 1.5 feet were used for the lead analyses and maximum values in the depth profile were used for the other metals. Use of this soil characterization maximizes the amount of data utilized, and also provides conservative estimates of exposures; as contamination at depth often exceeds surface concentrations, it is a better indicator for occupational exposures, and also conforms with current EPA guidance concerning sparse data sets. Complete development of the tabular data is provided in Attachment A to the Risk Assessment.

For areas where residential protective barriers will be established, the assumed post-response action concentrations for the contaminants of concern will be the concentrations within the “clean” barrier material. Specifications for the barrier material require that metals concentrations within the material cannot exceed the following BHSS clean soil requirements: Pb: 100 mg/kg, Zn: 100 mg/kg, As: 100 mg/kg, Cd: 5 mg/kg (MFG, 1994). The samples taken from the main line and siding ballast are referred to as “Center” in Tables 4a-h; the samples taken from the surrounding areas of the ROW are referred to as “North-South” in Tables 4a-h. The “overall” arithmetic average (for lead) and maximum value (for arsenic, cadmium and zinc) for the combined Center and North-South portions of the ROW were used as the concentration values in Tables 5-8 for the “No Action” Alternative. As discussed below, barriers and/or removals will be performed within the readily accessible portions of the residential area ROW. The post-response action exposure point concentrations will be that of the barrier material (ie. 100 mg/kg for Pb). In recreational areas the center mainline portion of the ballast will be covered with an asphalt barrier that also serves as the trail surface. The North-South portions of the ROW will remain exposed and the arithmetic average or maximum concentration found within the North-South area represents the post-response action concentration.

Except for that portion of the ROW between Harrison and Plummer, the response action proposed for the center areas of the ROW includes removal of the railroad ties and track to be followed by the placement of a protective barrier over the remaining ballast portion of the ROW. “Center areas of the ROW” as used in this risk assessment refers to the generally elevated portion of the ROW where the railroad ties and track have been laid on top of the ballast material. In the North-South portion of the ROW (the areas of the ROW on either side of the center areas), the proposed response action generally differs between designated residential areas and more isolated recreational segments (i.e. non-residential). Between Harrison and Plummer, the proposed response action calls for complete removal of ballast in the ROW.

Physical response activities (removal of contaminants and installation of a protective cap) are not proposed for the North-South portions of many parts of the remote recreational segments, especially where these segments lie within the river floodplain. In the segments that are designated residential areas, the proposed response action for the North-South portion of the ROW will include both selected removals of ballast and coverage of the accessible North-South portion of the ROW with a protective barrier. The response action proposed for the former railroad sidings outside of designated residential areas includes the removal of ballast material on which the siding

tracks and ties were formerly placed, and the installation of a protective barrier over the siding areas, for a length up to 1000 feet.

The following paragraphs briefly discuss the characteristics and proposed candidate response actions for each sub-section. The trail segments are divided from east to west (Mullan to Plummer) and presented in the same direction.

0.4.2 The Silver Valley upstream of the Bunker Hill Superfund Site

Segment 1-Mullan Community Area: This portion of the line extends from milepost 6 to 7 and passes through the town of Mullan. The ROW functionally encompasses approximately 1½ acres in this segment. Two siding areas are included within the Mullan city limits. About 3000 feet of ROW are adjacent to commercial and residential properties within the community and about 1000 feet about mining and mine wastes facilities.

Approximately 800 people reside in Mullan, and all are estimated to live within one mile of the proposed trail in this segment. Eleven children and 68 adults were tested for lead absorption in this area in 1996. Average blood lead levels were 3 µg/dl for 0 to 6 year old children, 4 µg/dl for 7 to 9 year old children, and 4 µg/dl for adults. No children exhibited lead toxicity (i.e., blood lead levels exceeding 10 µg/dl) (Table 3b).

Lead concentrations in the ballast average 16,737 mg/kg. Average (arithmetic mean) lead concentrations are 13,363 mg/kg in soil areas that are mostly gravel, adjacent to the rail line (Table 4a). Residential yard soil lead concentrations in Mullan range from 41 to 20,218 mg/kg, with an arithmetic mean of 1212 mg/kg (Table 3a).

This segment of the proposed trail is considered residential. The proposed response action for this area includes the removal and consolidation of siding ballast, placement of an asphalt cap over the central portion of the trail corridor, installation of a clean soil or asphalt cap across the remaining functional width of ROW in much of the downtown area, and installation of fencing to preclude access to adjacent mine waste containment facilities. Estimated post-response action soil lead concentrations in the installed barrier areas will be less than 100 mg/kg.

Segment 2-Morning Mine Dump to Woodland Park: This portion of the proposed trail is predominantly remote recreational, with a single residential area near Golconda receiving approximately 2000 feet of protective barrier. A barricade will also be added as necessary to avoid safety hazards where the trail and I-90 are in close proximity. Lead concentrations within the ballast average 12,333 mg/kg. Soil areas adjacent to the ROW average 4023 mg/kg lead (Table 4a). The proposed response actions for this area include placement of an asphalt cap over the central ballast portion of the trail corridor. Estimated post-response soil lead concentrations in the installed barrier areas will be less than 100 mg/kg. Lead levels in the unremediated north and south portions of the ROW will remain approximately 4000 mg/kg (Tables 8d-f). These areas are largely steep, difficult to access and present physical hazards in addition to being uninviting to

children or other trail users. As a result, the contact times assumed in the risk analyses are unlikely to occur in these areas and are conservatively used in these analyses.

Segment 3-Wallace to Silverton: This portion of the line extends from milepost 1 of the Mullan Branch to milepost 79 of the Wallace Branch, and passes through the town of Wallace. The functional ROW encompasses approximately 5 acres in this segment, all within the City of Wallace, and includes areas under the elevated interstate highway and about two acres through the old Wallace railroad yard. About 10,000 feet of ROW are adjacent to commercial and residential properties within the community.

Approximately 1000 people reside in Wallace and 150 in Silverton. Nearly all of these people are estimated to live within one mile of the proposed trail in this segment. Forty-five children and 172 adults were tested for lead absorption in this area in 1996. Average blood lead levels for 0 to 6 year old children were 6 µg/dl in Wallace-Silverton; 7 µg/dl for 7 to 9 year old children, and 4 µg/dl for adults. Approximately 20% of children exhibited lead toxicity, with blood lead levels exceeding 10 µg/dl (Table 3b).

Lead concentrations within the ballast average 10,263 mg/kg. The adjacent ROW averages 7054 mg/kg (Table 4a). Residential yard soil lead concentrations in Wallace range from 54 to 4285 mg/kg, with an arithmetic mean of 777 mg/kg (Table 3a).

This segment of the proposed trail is considered residential. The proposed response action for this area includes: installation of an asphalt cap from pillar to pillar under the Interstate; and installation of a clean soil and asphalt cap across a 26 foot width of the ROW through the Wallace Yard area; removal of siding ballast; and enclosure of the 26 foot wide corridor with fencing. Estimated post-response soil lead concentrations in the installed barrier areas will be less than 100 mg/kg.

Segment 4- I-90 at Silverton to Osburn: This portion of the proposed trail extends from about milepost 79 to 77 and is predominantly remote recreational. This segment does include about one mile of mixed industrial and natural resource uses in the area between the two cities. No environmental media metals concentration data are available for this segment. Asphalt capping of the central ballast portion of the trail corridor is proposed. The remainder of the ROW within this segment is well vegetated and does not require a barrier. There is a private road crossing within this segment that could be used as an access point for the trail. As a mitigation measure this road will be gated to prevent it from becoming an access point for the trail.

Segment 5-Osburn: This segment extends from milepost 73 to 77 and passes through the town of Osburn. The functional ROW encompasses approximately 40 acres in this segment, with a large siding area within the Osburn city limits. The remainder of this segment is adjacent to commercial and residential properties within the community.

Approximately 1600 people reside in Osburn, and most are estimated to live within one mile of the proposed trail in this segment. Twenty-one children and 165 adults were tested for lead

absorption in this area in 1996-97. Average blood lead levels were 4 µg/dl for 0 to 6 year old children, 4 µg/dl for 7 to 9 year old children, and 4 µg/dl for adults. Approximately 5% of children exhibited lead toxicity, with blood lead levels exceeding 10 µg/dl (Table 3b).

Lead concentrations within the ballast average 17,720 mg/kg. The adjacent ROW averages 1070 mg/kg in soil and gravel (Table 4a). Residential yard soil lead levels in Osburn range from 43 to 12,884 mg/kg, with an arithmetic mean concentration of 727 mg/kg (Table 3a).

This segment of the proposed trail is considered residential. The proposed response actions for this area include: removing 18 inches of ballast and contaminated soils; placement of an asphalt cap across the central ballast portion of the trail corridor, and installation of a clean soil cap or equivalent barrier across the remaining functional width of ROW. This segment also includes a remote area from the west end of Osburn to the Big Creek/Shont siding, from about milepost 73.8 to 72.8. This area parallels the river channel where sediment lead levels from sources not addressed within this EECA exceed 5,000 mg/kg. An asphalt cap will be installed over the central ballast portion of the trail corridor within this remote area and a gravel barrier will also be installed on the bench area along that portion of the river that is adjacent to the railroad mainline and proposed trail. Estimated post-response soil lead concentrations in the installed barrier areas will be less than 100 mg/kg.

Segment 6-Big Creek/Shont to Elizabeth Park: This portion of the proposed trail is predominantly remote recreational. Lead concentrations within the ballast average 37,100 mg/kg. The North and South portions of the ROW average 8525 mg/kg and ranges up to 17,900 mg/kg in adjacent soil areas (Table 4a, Attachment A). The proposed response actions for this area include: placement of an asphalt cap over the central ballast portion of the trail corridor; removal of the siding ballast; and the installation of approximately 100 feet of clean barrier west from the road crossing at Shont. The areas immediately adjacent to the BHSS will receive a 1500 foot residential barrier from the BHSS boundary to 1000 feet beyond the eastern-most residence located near Goldhunter Creek. Due to the expected elevated lead concentrations from fluvially deposited tailings near the river, the north side of the ROW will be fenced adjacent to the trail to limit access to the river banks and flat bench area between the river and the ROW. The south side of the ROW will be covered with clean gravel and fenced between the road and the trail. These response actions will result in an effective post-response action lead concentration of 100 mg/kg or less throughout accessible portions of this segment.

0.4.3 The Bunker Hill Superfund Site

Segment 7-Bunker Hill Superfund Site (BHSS): Risks within the BHSS have previously been evaluated as part of the development of the Record of Decision (ROD) for the site and are not addressed in the analysis presented herein. The *Risk Assessment Data Evaluation Report for the Populated Areas of the Bunker Hill Superfund Site* assesses residential exposure and risk to heavy metals for the 21 square mile area (TerraGraphics, 1990). The *Non-populated Areas of the Bunker Hill NPL Site* assesses risks in the non-populated parts of the site (SAIC, 1992).

0.4.4 The Lower Basin - Bunker Hill Superfund Site to Harrison

Segment 8-BHSS to Cataldo: This segment extends between mileposts 63 and 58 and is generally remote recreational with road access occurring only near Enaville. Lead concentrations within the ballast average 7972 mg/kg. The ROW averages 3954 mg/kg lead in adjacent soil areas (Table 4a). The proposed response actions for this area include placement of an asphalt cap over the central ballast portion of the trail corridor. Lead concentrations off the trail portion of the ROW will remain at approximately 4000 mg/kg (Tables 8d-f).

This section of the proposed trail presents particular risk management challenges because the ROW parallels the river. This section of the river contains several attractive beaches that have been contaminated by fluvially deposited tailings, and is subject to frequent flooding and re-deposition of contaminated sediments. As a result, clean rest areas in locations not prone to flooding are proposed to attract trail users away from the contamination. Information regarding potential contaminant hazards will also be provided within these areas.

Segment 9-Cataldo: This portion of the line extends from milepost 57 to 58 and passes through the town of Cataldo. This segment of the proposed trail is considered residential. The ROW encompasses approximately 6 acres in this segment. The remainder of the ROW is adjacent to commercial and residential properties within the community, and about 500 feet is adjacent to a private campground and park area located on the west end of the town.

Approximately 100 people reside in the Cataldo area within one mile of the proposed trail in this segment. Results for the 1996 blood lead absorption study for this area include Cataldo and the Lower Basin, discussed in the next segment. Observed blood lead absorptions in this area were 6 µg/dl for 0 to 6 year old children, 3 µg/dl for 7 to 9 year old children, and 4 µg/dl for adults. Approximately 23% of children in the Lower Basin exhibited lead toxicity in 1996, with blood lead levels exceeding 10µg/dl. These data are presented in Table 3b under the heading “Lower Basin” and include survey data from Cataldo to Medimont.

Lead concentrations within the ballast average 4376 mg/kg and adjacent soils in the ROW averaged 1439 mg/kg lead (Table 4a). Residential yard soil lead concentrations in Cataldo and the lower Basin area range from 15 to 8643 mg/kg, with an arithmetic mean concentration of 571 mg/kg. These data are presented in Table 3a under “Lower Basin.”

The proposed response actions for this area include: ballast removal in the siding area; placement of an asphalt cap over the central ballast portion of the trail corridor; and installing a clean soil cap or equivalent barrier across the remaining functional width of the ROW. Estimated post remedial soil lead concentrations in the installed barrier areas will be less than 100 mg/kg.

Segment 10-Cataldo to Harrison: This portion of the proposed trail extends from milepost 32 to 57 and is predominantly recreational with small residential areas near the Dudley siding, Rose Lake, Medimont, and Lane. Medimont and Rose Lake are the largest residential areas within this segment. The remainder of the ROW is remote, adjoining agricultural and natural resource lands

with restricted access to trail users. Approximately 350 people reside in the lower Basin area from Cataldo to Harrison, and most live within one mile of the proposed trail in this segment.

Lead concentrations within the ballast in this segment average 7345 mg/kg. The adjacent ROW averages 2406 mg/kg (Table 4a). The proposed response actions for this area include placement of an asphalt cap over the central ballast portion of the trail corridor. Estimated post-response action soil lead concentrations in the center trail corridor will be less than 100 mg/kg. Soil lead levels, largely attributed to fluvially deposited tailings within the ROW, will remain at approximately 2400 mg/kg (Tables 8d-f). Soil lead levels in river sands found in flood-prone areas in and adjacent to the ROW are typically 5000 mg/kg.

This section of the proposed trail presents particular risk management challenges because the ROW parallels the river and is subject to frequent flooding and deposition of contaminated sediments. As a result, oases of clean areas in locations not prone to flooding are proposed near Dudley, Rose Lake, Lane, and Springston. These oases areas will include rest stops and picnic amenities and will provide information regarding contaminant hazards in the following segments (Lower Basin - Residential, Harrison, Harrison to Heyburn State Park, and Heyburn State Park to Plummer).

Lower Basin-Residential: This segment includes residential areas in the Lower Basin include Rose Lake (at about milepost 49) and Medimont (at about milepost 41). Both are communities with less than thirty homes. Samples from a site about one half mile east of Medimont, near milepost 42 show lead concentrations within the ballast average 4857 mg/kg. The adjacent ROW averages 4352 mg/kg (Table 4a). The proposed response actions for this area include: placement of an asphalt cap over the central ballast portion of the trail corridor and the installation of a clean soil cap or equivalent barrier across the remaining functional width of the ROW. Estimated post-response action soil lead concentrations in the installed barrier areas will be less than 100 mg/kg.

Segment 11-Harrison: This portion of the line extends from milepost 30 to 32 and passes through the town of Harrison. The ROW encompasses approximately 5 acres in this segment. The ROW is adjacent to commercial and residential properties within the community. Approximately 1000 feet of the ROW is located adjacent to a private marina and the Coeur d' Alene Lake beach and park area located near on the west end of the City.

Approximately 225 people reside in Harrison, and all live within one mile of the proposed trail in this segment. No children or adults were tested for lead absorption in this area in 1996-97 surveys. Lead concentrations in the ballast average 13,125 mg/kg. The adjacent ROW shows average levels of 3334 mg/kg in soil areas (Table 4a). No residential soil contamination data are available for Harrison.

This segment of the proposed trail is considered residential. The proposed response actions for this area include: removal of ballast in the siding areas; placement of an asphalt cap over the central ballast portion of the trail corridor; and installation of a clean soil cap or equivalent barrier

across the remaining functional width of ROW. Estimated post remedial soil lead concentrations in the installed barrier areas will be less than 100 mg/kg (Tables 8d-f).

0.4.5 Coeur d' Alene Indian Reservation

Segment 12-Harrison to Heyburn State Park: This segment of the rail line, extending from milepost 31 to 24, runs along the shore of Lake Coeur d' Alene from Harrison to the large bridge/trestle crossing at Lake Chatcolet. The ROW is largely recreational with little road access. Lead concentrations in the ballast average 15,448 mg/kg. The adjacent ROW averages 84 mg/kg in soil areas (Table 4a). The proposed response actions for this area include: removing all visually identifiable ballast within the ROW and providing a clean gravel base for the trail. This action should eliminate most contaminated soils in the remainder of the ROW. The trail will not be asphalted in this section. Estimated post-removal soil lead concentrations will be less than 100 mg/kg.

Segment 13-Heyburn State Park to Plummer: This section of the proposed trail extends from milepost 24 to 16.6 and is largely remote, bordering agricultural and natural resource lands between the large State Park facility at Heyburn and the Plummer Junction at the ROW terminus. The trail will connect the City of Plummer with Plummer Junction via a non-ROW route. Approximately 200 summer homes and some permanent residences are located at Heyburn, and Plummer has a population of 800, all located within one mile of the proposed trail. No blood lead absorption testing or residential soil contamination sampling has been conducted in this area. Lead concentrations in the ballast area average 10,015 mg/kg. The ROW has lead concentrations averaging 1305 mg/kg in adjacent soil areas (Table 4a). The latter average is largely influenced by one particularly high value. The proposed response actions for this area include: removing all visually identifiable ballast within the ROW and providing a clean gravel base for the trail. Successful identification and removal of the ballast should reduce the average central trail corridor concentration to less than 100 mg/kg and to approximately 540 mg/kg in the north/south portions (Tables 8d-f).

Section 0.5 Exposure Assessment

This section identifies uses and activities that may result in human exposure to the contaminants of concern. Sensitive sub-populations, environmental exposure pathways, routes of intake, and quantification of intake rates are selected by identifying and appropriately characterizing exposure scenarios.

A major concern in evaluating risks associated with the proposed trail is exposure to contaminants on adjacent lands. Soil, sediment, and water contamination by heavy metals is ubiquitous throughout the Coeur d' Alene Basin. The ROW trail will provide access and invite and encourage people to recreate in areas where they could potentially be exposed to significant concentrations of metals in various media. In many areas these exposures are ongoing today. Recreational facilities are already established, and large numbers of people currently access these

areas by boat and automobile. The trail is expected to increase the number of visitors and will add to demands on amenities and resources.

These ongoing and potential exposures cannot be fully resolved by response actions on the properties addressed in this EECA. However, there are risk management strategies that can be developed as part of the EECA response action to minimize exposures within the ROW and to mitigate off-trail exposures until response actions can be evaluated for adjacent lands through the Bunker Hill Basin-wide RI/FS. The following discussion addresses potential exposures for users both on the post-response action trail and on adjacent recreational lands. However, in the following EECA assessments, only a limited number of scenarios are evaluated. These assessments address only the trail properties and the potential effects of the proposed response actions. In general, risk assessments typically consider three intake routes - inhalation, ingestion, and dermal contact. Only the ingestion pathway for soils is fully developed for the EECA analysis. Dermal and inhalation pathways are assessed by providing example calculations relating potential exposures from these routes to the ingestion pathway in the RME analysis.

Three categories of exposure scenarios are addressed in this assessment: i) residential, ii) recreational, and iii) occupational. Each of these categories is discussed in the following section with respect to exposures that might occur in association with post-response action trail use. However, as explained at the beginning of this Risk Assessment, only *incremental exposures* associated with contaminated soil ingestion from the ROW are fully considered in the intake and risk analysis.

0.5.1 Residential Exposures

Numerous residences are adjacent to the proposed trail in many populated areas along the seventy-two mile route. In these areas, the trail could become part of the typical residential exposure scenario for those residents. A residential scenario refers to cumulative site-related exposures in a community. For example, a child living in one of the upper basin towns may be exposed to heavy metals in his/her house dust, soil from the front and back yards, soil and dust in community parks, nearby play lots, and the trail area. Experiences within the Bunker Hill Superfund site suggest that contaminated recreational areas in the vicinity of local residences can contribute substantially to absorption of excessive concentrations of metals. Supervised 1 to 3 year old children and largely unsupervised 6 to 9 year old children are the most sensitive sub-populations of this group. Many of these children already carry a significant body burden of lead associated with current exposures to soils, dusts and other sources as shown in Tables 3a and 3b.

A comprehensive risk assessment such as the one being performed as part of the Bunker Hill Basin-wide RI/FS evaluates all potential exposures including both the baseline and incremental effects to children that access contaminated areas on or adjacent to the trail. Such analyses should include all ongoing exposures in the home and community and consider observed baseline blood lead levels. *However, these in-home and community-wide residential exposures are not evaluated in this assessment.* Activities described in the EECA and evaluated within this risk assessment will reduce only that portion of the total contaminant exposure that may be associated with the

ROW. Only that incremental reduction is evaluated within the risk assessment presented in this assessment.

0.5.2 Recreational Exposures

Several recreational activities are anticipated on, and in association with, the proposed trail being developed in conjunction with the response action. These recreational uses should be evaluated as sources of incremental exposures to contamination or particular behaviors and practices that add to baseline exposures. Recreational uses of the trail and its environs can be classified as either land-based or water-based activities. On-trail activities are likely to include walking and running for exercise, hiking (including access for specific purposes such as bird watching, berry or mushroom collecting, nature trekking, etc.), biking, roller-blading, and horseback riding. Recreational users of the trail may use it to gain access to fish, game, and food. Food, particularly wild rice, berries, and water potatoes, could be accessed. Flooding or dust generated on the trail could cause deposition of contaminated particulate onto rice and berries.

Both trail users and power boaters, canoeists, and rafters on the Coeur d'Alene River or chain lakes will be typical users, particularly from March to October. These users may use the river to access the trail. Their activities will include beach time, swimming, picnicking, and camping. Hunters, fishermen, and swimmers will likely access the river and lakes from the trail. The access provided by the proposed public trail will increase the attractiveness of these activities. The section of the ROW from DeSmet (Plummer) to Cataldo is a Coeur d'Alene Tribe ancestral trail. The Tribe desires to use the portion of the trail and associated rights-of-ways between Plummer and Harrison for general and ceremonial horse-packing trips. Many activities will result in camping and extended stays of up to two weeks. In the context of comprehensive assessment of off-trail exposures, harvest and consumption of wild foods and local waters should be assessed.

A comprehensive risk assessment of potential park/trail activities should include some consideration of these various activities. These analyses should also evaluate the potential for higher than typical rates of ingestion of contaminants associated with certain activities. For example, much higher than normal soil/dust ingestion rates would be expected with mountain biking or horseback camping scenarios. Determining appropriate ingestion rates, types of wild foodstuffs that might be consumed, and preparation methods will require investigation and consultation with potential users, including consideration of Native American cultural practices.

However, the associated off-trail exposures described above are beyond the scope of the EECA and are not resolvable by response actions in the ROW. This assessment addresses only the EECA proposed response action and does not include cultural or recreational off-trail exposure components. As previously stated, EPA and the State of Idaho are currently performing a comprehensive RI/FS for the Coeur d'Alene Basin that will investigate the extent of hazardous substances and cleanup actions needed throughout the Basin.

0.5.3 Occupational Exposures

There are potential concerns relating to exposure to hazardous substances for employees of the Department of Parks and Recreation, Tribal employees, and contract labor. On-site employees would experience the same exposures as users, but over a longer period of time, and would have additional exposures associated with specific work-related activities. Typical worker activities include: driving; sweeping trails; digging post holes for signs and fences; building and repairing berms; removing fallen branches and logs; patching trails; spraying weeds; picking up trash from trails, edges, and water; grading parking lots; cleaning restrooms; enforcing rules; removing collected sediments; handling creosote trestles; removing campfires; and other general maintenance activities. Barriers and protective caps would be penetrated by both employees and contractors placing signs, fence rails, constructing rest room facilities, etc. The same people will typically pick up trash, clean culverts, and move fallen branches and other debris from the trail; consequently, those individuals would be exposed to contaminants along the sides of the right-of-way, on beaches, in parking areas and campgrounds, and in the water.

It is likely that the Tribe and the Department would have permanent workers who base their operations on both ends of the trail, as well as part-time workers operating from locations in the middle sections. It is not unusual for the Department or the Tribe to have rangers located in one park throughout a 30-year career. Some seasonal workers are known to be long-time employees. The Department is actively recruiting female rangers. With regard to lead, women of reproductive age would be the sub-population of the occupational exposure group most sensitive to occupational exposures. Occupational Safety and Health Administration (OSHA) guidance and standards for lead-related industries are likely inappropriate for consideration among recreational-based employees.

0.5.4 Select Exposure Scenarios for the EECA Streamlined Risk Assessment

For EECA purposes, three basic exposure scenarios have been evaluated: residential, recreational, and occupational. For residential exposures, pre-school children and pregnant women are considered to be the population most at-risk. Baseline contaminant intake and risk estimates are not developed for residential exposure scenarios. Rather, for exposures in residential areas, risk is evaluated by comparison of the projected post-response residential area soil contaminant concentrations to cleanup levels at the BHSS.

Recreational and occupational scenarios were defined and evaluated in the *Human Health Risk Assessment for the Non-populated Areas of the Bunker Hill NPL Site* (SAIC, 1992). In that risk assessment, incremental exposures to contaminants in the non-residential portions of the BHSS were evaluated for workers and casual recreational visitors. Because of similarities in contamination characteristics, sensitive populations, projected land uses, and routes of exposure, the parameters utilized within the BHSS assessment are appropriately being used to evaluate the occupational risk and one scenario for recreational risk exposures associated with the proposed response action. As discussed previously, recreational risks are evaluated utilizing four different sets of assumptions of exposure scenarios.

In addition to the casual recreational user scenario used in the BHSS assessment, this risk assessment also presents a second adult and child recreational scenario (the Modified Trail scenario). This second recreational scenario assumes adult and child recreational users who use the trail for 24 hours per week on a seasonal basis rather than the 20 hour (for adults) and 10 hour (for children) use rates in the BHSS scenario. This scenario was added because the BHSS risk assessment considered only casual visits to undeveloped recreational properties. A longer recreational usage time on the trail was included in this Modified Trail scenario because the proposed trail is being developed specifically to invite recreational uses. A time partition factor (TPF), discussed in section 0.5.5.1, was developed to represent the fraction of the time related to incremental exposure. This fraction was multiplied by the typical daily soil ingestion rate of 100 mg/day. For example, the BHSS and Modified Trail scenarios, respectively, assume that a child spends about 10% and 25% of waking hours on the trail. This results in trail-specific soil ingestion rates of approximately 10 mg/day and 25 mg/day for children in the BHSS and Modified Trail scenarios, respectively.

A third reasonable maximum exposure (RME) use scenario for the adult recreational and occupational scenarios was developed for arsenic, cadmium and zinc using the Region X RME guidance. For the adult recreational scenario, a maximum ingestion rate of 300 mg/day (or event) was applied with an exposure event frequency of two days per week for five months. This ingestion rate value is consistent with studies by Van Wijnen et al., (1990) as cited in the EPA Exposure Factors Handbook (USEPA, 1997). For the occupational scenario, an annual average ingestion rate of 200 mg/day for 219 work days per year was used for the occupational RME. This value was derived by assuming that workers would consume 400 mg/day, 5 days/week for five months; 100 mg/day, 5 days/week for four months; and no soil ingestion for three months in the winter. The 400 mg/day soil ingestion estimate is adapted from a study by Hawley (1985). Hawley's adult soil ingestion rate of 480 mg/day was estimated for an adult spending 16 hours/week gardening for 6 months of the year. The 200 mg/day annual average is consistent with current USEPA Region X guidance.

The RME ingestion rates are assumed to be that amount of dirt ingested while on the trail as opposed to BHSS and Modified Trail Scenarios where the ingestion rates are assumed to be a fraction of the total typical daily ingestion rate. As a result, the time partition factor (TPF) is not used for the RME analysis.

A fourth adult recreational and occupational analysis was conducted utilizing the USEPA Adult Model for Lead. This assessment assumes a 50 mg/day (or event) ingestion rate, and two day per week visits to the trail for five months. Pregnant women represent the most sensitive sub-population for these scenarios, and risk is evaluated against projected blood lead levels as suggested in the EPA guidance titled *Recommendations of the Technical Review Workgroup for Lead for an Interim Approach to Assessing Risks Associated with Adult Exposures to Lead in Soil* (Interim Approach) (EPA, 1996).

Each of the scenarios (i.e., BHSS, Modified Trail, EPA Adult Model, and RME) were evaluated for both No-action (i.e., if the use scenarios were applied to the railroad corridor in its present

condition) and post- response action contaminant concentrations indicated in Tables 5-8. The scenarios were applied to the trail segments indicated in Table 2. The Mullan, Wallace-Silverton, and Osburn segments represent residential exposure scenarios in the Silver Valley and the Cataldo and Harrison segments represent residential exposure scenarios in the Lower Basin. The Morning Mine-Woodland Park, Cataldo-Harrison, and Heyburn-Plummer segments represent remote recreational exposure potential in each of the three main trail areas; and Osburn-BHSS and BHSS-Cataldo represent the worst case No-Action situations. The BHSS segment is excluded from the assessment, as the BHSS was analyzed as part of the RI/FS and RODs previously issued by EPA for that area.

0.5.5 Intake Estimates

Intake estimates for the BHSS, Modified Trail and EPA Adult Model for lead scenarios are developed by assuming that 100 mg/day of soil is ingested in all activities and then applying a time partition factor to account for the amount of soil ingested while on the trail. The USEPA Adult Model for lead assumes an absolute soil intake rate of 50 mg/day associated with a trail event, or day in this case, and specifies the number of events to occur during the exposure period. Intake estimates for the RME scenario are developed from maximum soil ingestion rates applied per event while on the trail.

0.5.5.1 Typical Intake Calculations for BHSS and Modified Trail Scenarios

The general equation used to estimate chronic intakes by humans via a particular exposure route is:

$$CDI = C \times HIF$$

where:

CDI = Route specific Chronic Daily Intake (mg of chemical per kg body weight per day)

C = Mean concentration (mg of chemical per unit of medium; for soil, mg of chemical per kg of soil)

HIF = Route and pathway Human Intake Factor (unit of medium per kg of body weight per day; for soil, kg of soil per kg of body weight per day)

$$= \frac{IR \times TPF \times EF \times ED}{BW \times AT}$$

IR = Total daily intake rate (mg/day for soil)

TPF = Time Partition Factor (unitless)

	=	Correction representing fraction of time related to incremental exposure
EF	=	Exposure Frequency (weeks/year)
ED	=	Exposure Duration (years)
BW	=	Body Weight (kg)
AT	=	Averaging Time (=ED x EF for non-carcinogens and 70 years x 52 weeks/year for carcinogens)

Maximum concentrations (C) for the various segments are shown in Tables 5 through 8 for both pre-and post-removal conditions. For purposes of this risk assessment, Total Chronic Daily Intakes (CDI) are determined only for the trail-related exposures and average or typical conditions. USEPA guidance recommends evaluating exposure based on both the best estimates and the upper-bound estimates for environmental media concentrations. Only chronic exposures (versus sub-chronic) for arsenic, cadmium, and zinc are evaluated for the EECA, using maximum concentrations. This determination is based on USEPA guidance regarding sparse data sets. This approach differs from the average values used in the BHSS assessment in that an individual would not be exposed to upper-bound concentrations for an entire lifetime.

Time Partition Factor (TPF) and Human Intake Factor (HIF) values were developed for the incremental exposures discussed in a previous section (0.5). The TPF indicates the fraction of waking hours that an individual is exposed to trail media and the HIF reflects intake rates associated with trail exposures. HIF values are averaged over the EF x ED for non-carcinogens and over 70 years for carcinogens. These values were determined for each of the exposure scenarios and contact media as shown in Table 1. For example, the Chronic HIF for the typical 6 to 15 year-old recreational scenario is calculated as follows:

The Time Partition factor (TPF) is:

$$\frac{10 \text{ hrs/wk}}{14 \text{ waking hrs/day} * 7 \text{ days/wk}} = 0.102 (\text{waking hours})$$

where 10 hrs/wk is the “time on trail” (Table 1).

The HIF for carcinogens is:

$$\frac{(100 \text{ mg/day})(10^{-6} \text{ kg/mg})(0.102)(16 \text{ wk/yr} * 10 \text{ yrs})}{(39 \text{ kg})(70 \text{ years})(52 \text{ wk/yr})} = 1.15 \times 10^{-8} \text{ kg/kg/day.}$$

The HIF for non-carcinogens is:

$$\frac{(100 \text{ mg/day})(10^{-6} \text{ kg/mg})(0.102)(16 \text{ wk/yr} * 10 \text{ yrs})}{(39 \text{ kg})(10 \text{ years})(16 \text{ wk/yr})} = 2.62 \times 10^{-7} \text{ kg/kg/day.}$$

Intake rates and CDIs are summarized for each trail segment and scenario in Tables 5a-c, 6a-c and 7a-c for the No-action scenario and Tables 5d-f, 6d-f and 7d-f for post- response action conditions, respectively, for arsenic, cadmium, and zinc. Estimated pre- and post-response action lead intake rates are found in Tables 8a-b and 8d-e, for the BHSS and Modified Trail scenarios.

0.5.5.2 Intake Calculations for the USEPA Adult Model for Lead Scenario

The USEPA Adult Model for lead guidance suggests that adults typically ingest 50 mg/day of soil and dust in occupational settings. For the purposes of this EECA it is assumed that the entire 50 mg/day derives from the trail, 2 days/week for 5 months per year in the adult recreational scenario and for 219 days/year in the adult occupational scenario. This results in average intake rates of 14 mg/day and 30 mg/day trail specific soil ingestion for the recreational and occupational scenarios, respectively. Intake parameters are found in Table 8c.

0.5.5.3 Intake Calculations for Reasonable Maximum Exposure Scenario

The above HIF is typical for the BHSS and Modified Trail analyses. However, RME analysis, based on the aforementioned USEPA Adult Model for lead (*Recommendations of the Technical Review Workgroup for Lead for an Interim Approach to Assessing Risks Associated with Adult Exposures to Lead in Soil*), (EPA, 1996), assumes the ingestion rates are representative of how much soil is ingested while on the trail. As a result, the TPF is excluded from the HIF for the RME analysis.

$$\text{HIF} = \frac{\text{IR} \times \text{EF} \times \text{ED}}{\text{BW} \times \text{AT}}$$

IR = Intake rate (mg/day for soil)

EF = Exposure Frequency (weeks/year)

ED = Exposure Duration (years)

BW = Body Weight (kg)

AT = Averaging Time (=ED x EF for non-carcinogens and 70 years x 52 weeks/year for carcinogens)

For the RME analyses, adult recreational scenarios apply a 300 mg/day maximum soil ingestion rate, twice per week for 5 months. This results in effective average ingestion rates for the exposure period of 85 mg/day. For the adult occupational scenario, a maximum ingestion rate of 400 mg/day (or event) was applied with an event frequency of 5 days/week for five months; 100 mg/day for 5 days/week for four months; and no soil ingestion for three months in the winter. This results in an annual average soil ingestion rate of 200 mg/day for 219 days. RME intakes for pre- and post-removal conditions are found in Tables 5c and 5f, respectively, for arsenic; 6c and

6f for cadmium; and 7c and 7f for zinc.

0.5.5.4 Potential Dermal and Inhalation Potential Intakes

Dermal and inhalation intakes were also considered for comparative purposes in the RME scenario. The same exposure factors were used relative to exposure duration, frequency averaging time and body weight. For dermal exposure, available skin area was estimated at 2500 cm² and 4800 cm² for adult occupational and recreational exposures, respectively, assuming that adults in the recreational exposure scenario are wearing shorts and short sleeve shirts. Respective adherence factors were 0.2 mg/cm² for adult occupational and 0.1 mg/cm² for adult recreational scenarios, with an absorption factor of 0.03 for arsenic and 0.01 for cadmium and zinc (Kissel et al., in press, Holmes et al., in press). Pre- and post-removal dermal intakes are found in Tables 9a-f, respectively, for arsenic, cadmium and zinc. Table 10 compares RME dermal absorption to comparable ingestion CDIs. Dermal exposures to arsenic can range from 8% to 13% of ingestion intakes. Cadmium and zinc dermal exposures are 2% to 3% of ingestion intakes.

Exposure pathways include dermal contact with lead contaminated soils. Risks associated with dermal pathways can not be estimated using the *Recommendations of the Technical Review Workgroup for Lead for an Interim Approach to Assessing Risks Associated with Adult Exposures to Lead in Soil*, (EPA, 1996) because the model does not include a slope factor or other biokinetic algorithm for translating dermal exposures into estimates of blood lead concentration. As there is no other basis for estimating the contribution of the dermal pathway, lead risks were assessed assuming that the major lead uptake would result from the ingestion pathways.

Inhalation intakes assume similar RME exposure factors and are estimated using methods from EPA 1989 Exposure Factors Handbook (EPA, 1989). The inhalation exposure for airborne contaminants is estimated by the following:

$$I_{(\text{inhal})} = C \times IR \times EF \times ED \times EP$$

Where:

$I_{(\text{inhal})}$	=	Inhalation intake (µg/year)
C	=	Concentration of contaminant (µg/m ³)
IR	=	Inhalation rate (2.1 m ³ /hr)
EF	=	Event frequency (2 days/wk)
ED	=	Event duration (22 weeks/yr)
EP	=	Event period (8 hrs/day)

Assuming $0.1 \mu\text{g}/\text{m}^3$ air lead concentration consistent with BHSS observations and a moderate ventilation rate for average adults, yields a seasonal ventilation intake of $74 \mu\text{g}$. Assuming 50% retention and absorption in the lungs results in $37 \mu\text{g}$ per season lead absorption. This represents less than 3% of the typical ingestion rate for lead in the EPA Adult Model estimate.

There are no comparable air quality data available to assess arsenic, cadmium or zinc inhalation. However, the contaminant ratio in soils expressed as percentage of lead concentration for these contaminants range from 1% to 7% for arsenic, is less than 1% for cadmium, and from 30% to 140% for zinc. Assuming that these soils are the predominant source of potential airborne contaminant exposures, suggests that the air pathway represents a small fraction of potential intake in comparison to the ingestion pathway for these metals.

Neither dermal nor inhalation exposure routes are considered in the remaining analyses.

0.5.5.5 Comparison of Pre- and Post-response Action Intakes

Tables 5a-c through 8a-c show intake estimate calculations for each of the contaminants of concern for the No-action alternative. Estimates for arsenic, cadmium, and zinc are reported in dose or $\text{mg}/\text{kg}/\text{day}$ and lead is reported in sub-chronic rates of $\mu\text{g}/\text{day}$. Section 0.6.3 details the derivation of the lead sub-chronic intake. Tables 5a through 8a are for the BHSS Non-populated No-action areas scenarios, Tables 5b through 8b are for the Modified Trail No-action exposure periods, and Tables 5c through 8c are for the RME No-Action scenarios.

Tables 5d-f through 8d-f show corresponding results for the post-response action condition. Tables 11a-d summarize and compare pre- and post-response action concentrations for the four metals. Tables 11a-c summarize concentrations for arsenic, cadmium, and zinc and estimated percentage reduction expected with the response action. Table 11d shows similar results for lead concentration reductions.

For each scenario, percent reductions in intake parallel percent reductions in contaminant concentration levels. These results show that the proposed response action will achieve substantial reductions in metals intakes, especially in the residential areas. In the residential areas and in the Heyburn to Plummer remote section, estimated arsenic intakes are typically reduced in the range of 75% to 98%. Arsenic exposures in the Morning Mine to Woodland Park section are reduced 29%. Lower Basin residential arsenic levels are less than the proposed cleanup criteria. Cadmium and zinc intake reductions in most areas range from 18% to 99%, with no effective change in the Cataldo to Harrison segment. Potential lead exposures in remote areas are reduced in the range of 41% to 99% in most areas, with a 29% reduction in the BHSS to Cataldo segment. Potential lead exposures in residential areas are reduced in the range of 97% to 100%.

Section 0.6 Risk Assessment

Health risks associated with these intake rates were evaluated by estimating cancer risk for ingested arsenic and non-carcinogenic chronic health risk for arsenic, cadmium, and zinc, and by estimating incremental blood lead increases and 95th percentile projected blood lead levels for sub-chronic lead exposure.

0.6.1 Carcinogenic Risk

The carcinogenic risk from exposure to a chemical is described in terms of the probability that an exposed individual will develop cancer over a lifetime. This value is a function of the estimated chronic daily intake (CDI) and the slope factor (SF) for the chemical. The SF or Cancer Potency Factor (CPF) converts estimated chronic daily intakes, averaged over a lifetime of exposure, to a risk for an individual who might develop cancer. Assuming 100% absorption, cancer risk can be quantified by the equation:

$$\text{Cancer Risk} = 1 - \exp(-\text{CDI} \times \text{SF})$$

Where:

Risk = a unitless probability (such as 2×10^{-3}) of an individual developing cancer;

CDI = chronic daily intake averaged over 70 years (mg/kg/day)

SF = slope factor (mg/kg/day)⁻¹

When risks are estimated to be less than 0.01 (or 1×10^{-2}), the simplified linear low-dose cancer risk equation can be used:

$$\text{Cancer Risk} = \text{CDI} \times \text{SF}$$

According to the USEPA, the 10^{-6} (one in a million) risk level should be used as the “point of departure” for assessing baseline cancer risk and determining remedial goals for alternatives when ARARs are not available or are not sufficiently protective of human health because of the presence of multiple contaminants at a site. This means that a cumulative risk level of 10^{-6} is used as the starting point for evaluating protectiveness and for determining the most appropriate risk level that an alternative should be designed to attain. Risks exceeding 10^{-6} are less desirable, and the risk to individuals generally should not exceed 10^{-4} .

Tables 5a-f and 9a-b summarize incremental cancer risk estimates from exposure to arsenic, the only carcinogen in this analysis, for each scenario and representative trail segment.

0.6.2 Non-carcinogenic Risk

Non-carcinogenic risks are evaluated by comparing contaminant-specific CDIs for each of the chronic exposure pathways to the reference dose (RfD) published by the USEPA. Lead is not evaluated due to the lack of an appropriate RfD, but it is evaluated for sub-chronic risk by dose-response modeling analyses as discussed in Section 0.6.3.

The risk of non-carcinogenic effects from contaminant exposures is expressed in terms of the Hazard Quotient (HQ). The HQ is the ratio of the estimated chronic daily intake to the estimated dose level believed to be safe, the reference dose (RfD). It is expressed by the following equation:

$$HQ = CDI/RfD$$

Where:

HQ = Hazard Quotient (unitless)

CDI = Chronic Daily Intake (mg/kg/day)

RfD = Acceptable Intake for chronic exposure (mg/kg/day)

A Hazard Index (HI) for specific toxic effects and target organs (or endpoints) is estimated by summing individual contaminant hazard quotients. An HI is calculated separately for chronic and sub-chronic, and for shorter-duration, exposures. Concern for public health arises when an HI or HQ is greater than one (1.0). For sites where multiple contaminants exist, even if no single contaminant CDI exceeds its RfD, the total HI for the site may be greater than one due to the combined risks of exposures to multiple contaminants. For EECA purposes, however, only the HQ for a specific contaminant, for a specific scenario, is calculated and assessed as an incremental HQ. No assessment of other exposure routes has been calculated for this report and HQs are evaluated individually as incremental exposures using a screening criteria of $HQ > 0.1$.

Tables 5a-f through 7a-f and 9a-f summarize incremental non-carcinogenic risk estimates for arsenic, cadmium, and zinc for each scenario and representative trail segment.

0.6.3 Sub-chronic Risk for Lead

Potential blood lead increments for children (ages 6-15 years) and pregnant women are used to assess risk associated with lead exposures under the various scenarios and trail segments. For the BHSS and Modified Trail analyses, blood lead increments are estimated by the same formula applied in the BHSS Non-populated Areas Risk Assessment as follows:

$$PbB_{inc} = SDI \times \text{Absorption Rate} \times \text{Response Rate}$$

where:

$$PbB_{inc} = \text{estimated blood lead increment } (\mu\text{g/dl})$$

$$\text{SDI} = \text{Sub-chronic Daily Intake } (\mu\text{g/day}) = C \times \text{IR} \times \text{TPF}$$

Absorption Rate = fraction of lead absorbed

Response Rate = blood lead increase per unit absorbed lead ($\mu\text{g/dl}$ per $\mu\text{g/day}$)

Mean blood lead levels can then be estimated by adding the increment to the baseline blood lead level representing the population assessed. RME blood lead levels are determined by assuming a log normal distribution for the population with an appropriate geometric standard deviation (GSD). In the BHSS risk assessment, a post-remediation projected baseline blood lead level of $3.5 \mu\text{g/dl}$, a GSD of 1.6, and the 95th percentile RME were used (SAIC, 1992).

However, for this risk assessment different values for the baseline blood level and GSD are employed. U.S. EPA Region X recommends use of NHANES III Phase 1 data and the *Recommendations of the Technical Review Workgroup for Lead for an Interim Approach to Assessing Risks Associated with Adult Exposures to Lead in Soil* (EPA, 1996). The adult projections are based on typical national baseline blood lead levels for rural white, non-Hispanic female populations (i.e. mean baseline blood lead levels of $1.7 \mu\text{g/dl}$ for adults with a GSD of 1.89). (Brody D.J., Pirlke J.L., Kramer R.A., Flegal K.M., Matte T.D., Gunter E.W. and Paschal D.C. (1994) Blood lead levels in the US population, JAMA, 272:277-283.) The baseline blood lead level for children is $2.2 \mu\text{g/dl}$, resulting from combining baselines of $2.4 \mu\text{g/dl}$ and $2.1 \mu\text{g/dl}$ for children ages 6-11 and 12-19 years, respectively, in the same reference (Brody et al , 1994). The GSD of 1.89 is also used for the 6 to 15 year age group as a specific value is not available from the database.

The BHSS and Modified Trail methodologies and *Recommendations of the Technical Review Workgroup for Lead for an Interim Approach to Assessing Risks Associated with Adult Exposures to Lead in Soil* (Interim Approach) (EPA, 1996) are similar and use consistent techniques. Equation 1 of the Interim Approach calculates a central (average) estimate of adult blood lead concentrations associated with site exposures by adding the estimated increment to a mean baseline blood lead value representing absorption from other sources not associated with the incremental exposure.

Equation 1 of the EPA Adult Model interim approach results in the following equation:

$$\text{PbB}_{\text{adult,central}} = \text{PbB}_{\text{adult,baseline}} + (\text{PbS} \times \text{IR} \times \text{EF} \times \text{ED} \times \text{AF} \times \text{BKSF}) / \text{AT}$$

where:

PbS = site-specific soil lead concentration ($\mu\text{g/g}$)

IR = soil intake rate (g/event or day)

EF = event frequency (days/week)

ED = exposure duration (weeks/year)

AF = absorption factor (dimensionless)

BKSF = biokinetic slope factor (µg/dl per µg/day)

AT = averaging time (days/year)

In calculating the central blood lead level, the USEPA Adult Model for Lead suggests values of 12% absorption factor and 0.40 µg/dl per µg/day BKSF or response rate. In the BHSS Non-populated Areas risk assessment, an absorption factor of 20% and BKSF of 0.34 µg/dl per µg/day were used in the analysis. Subsequent analyses of blood lead and environmental media lead concentrations at the BHSS suggest these values have reasonably described response rates for children at the BHSS (TerraGraphics, 1997). However, for post-response action conditions at the BHSS and other potential sites, such as the Coeur d' Alene Basin, the USEPA Integrated Exposure Uptake Biokinetic Model (IEUBK) for lead default parameters of 30% absorption and 0.40 µg/dl per µg/day response rate may be more appropriate. As a result, the Modified Trail analysis uses these latter values to represent the upper range of response associated with older children and, potentially, for pregnant women. Due to the non-linear nature of the blood lead response, all increments greater than 15 µg/dl are reported as >15 µg/dl in all tables.

These models are similar in format, employ linear bio-kinetics, and are based on the assumption that blood lead levels in a uniformly exposed population are log-normally distributed. As a result the distribution of blood lead levels in a subject population can be described by two common statistics, the geometric mean (or central tendency) and the geometric standard deviation (or GSD). Using standard normal deviate z-tables, these statistics can be used to estimate that percentage of the population with blood lead levels exceeding particular health criteria. This methodology was first proposed in the lead health literature in 1977 by Yankel et al. in a study of epidemic lead poisoning near the primary lead/zinc smelter at Kellogg, Idaho. The technique was subsequently adopted by the USEPA in developing the proposed National Ambient Air Quality Standard for Lead (NAAQS) later the same year. The standard was promulgated in 1980 and relies on three underlying studies to support the methodology. The NAAQS remains in effect today (Yankel et al. 1977, Griffith et al. 1975, and Azar 1975, Federal Register December 14, 1980, Scheaffer and McClave, 1982).

The method was utilized in the analysis of blood lead levels in older children and adults in the Human Health Risk Assessment for the Non-Populated Areas of the Bunker Hill NPL Site in 1991, as described in this risk assessment (SAIC 1992). Later, Bowers 1994 proposed the technique for estimating blood lead levels and making comparisons to health criteria for adults in recreational settings. The USEPA subsequently adopted this technique in *Recommendations of the Technical Review Workgroup for Lead for an Interim Approach to Assessing Risks Associated with Adult Exposures to Lead in Soil* (Bowers 1994, USEPA 1996). This guidance recommends calculating mean or the central tendency blood lead levels and projecting 95th percentile blood lead levels using the following equation:

$$PbB_{adult, 0.95} = PbB_{adult, central} * GSD_i^z$$

where:

$PbB_{\text{adult, central}}$ = central tendency for adult blood lead, described above

GSD_i = Geometric Standard Deviation, and

z = standard normal deviate.

For these analyses a GSD equal to 1.89 representing non-hispanic, white populations was used for adults and children, and a z -value of 1.645 representing the 95th percentile was used as recommended by Region X and *Recommendations of the Technical Review Workgroup for Lead for an Interim Approach to Assessing Risks Associated with Adult Exposures to Lead in Soil, p.A-8*. (EPA, 1996)

USEPA Region X additionally suggests comparing predicted blood lead levels to the national health criteria that no more than 5% of the population exceed the 10 ug/dl blood lead level. This criteria is applied to adult women reflecting their surrogate status for the fetus. Assuming that maternal and fetal blood lead levels are similar, a projected 95th percentile blood lead level exceeding 10 ug/dl can be interpreted to suggest that more than 5% of the population is expected to have blood lead levels greater than the criteria level. If the central tendency or mean blood lead projection exceeds 10 ug/dl, then more than 50% of the population is expected to have blood lead levels exceeding 10 ug/dl. The 95th percentile blood lead level is sufficient information to make that determination. The percent of the population predicted to exceed 10 ug/dl can be calculated using the z -statistic by the following formula:

$$z = \frac{\ln(x) - \ln(\mu)}{\ln(\sigma)}$$

where z = the standard normal deviate,

x = 10 ug/dl,

μ = Adult Blood Lead, Central Tendency for given conditions, $PbB_{\text{adult, central}}$,

σ = Geometric Standard Deviation, 1.89 for log-normal blood lead distribution.

Using a standard statistical table, the probability of exceeding 10 ug/dl can be calculated from the standard normal deviate.

Because of the inherent linear bio-kinetics assumed in the model form, the projection of central and 95th percentile blood lead levels are reliable only near the proposed criteria. As a result, the blood lead levels and percent to exceed 10 ug/dl projected at high exposure rates are likely overestimated using this model format. However, there is certainty that particular thresholds are exceeded. As a result, the model projections in Tables 8a-f report mean and 95th percentile blood levels up to 15 ug/dl and percent to exceed 10 ug/dl up to 50%. Higher values are reported as >15 ug/dl and >50%, respectively.

Tables 8a-f summarize incremental lead absorption rates and estimated mean (central tendency) and 95th percentile blood lead concentrations for each scenario and representative trail segment. Tables 8c and 8f provide the results for the RME analyses using the *Recommendations of the Technical Review Workgroup for Lead for an Interim Approach to Assessing Risks Associated with Adult Exposures to Lead in Soil* (U.S. EPA, 1996). Older children (>72 months of age) and adults are treated the same in this methodology except that the baseline blood lead concentrations and time on trail estimates differ.

Five scenarios are presented in Table 8c and 8f. These are respectively, adult recreational and occupational scenarios using the 1.7 ug/dl baseline blood lead level; fetal recreational and occupational scenarios utilizing the *Recommendations of the Technical Review Workgroup for Lead for an Interim Approach to Assessing Risks Associated with Adult Exposures to Lead in Soil* (U.S. EPA, 1996) suggested fetal:maternal blood lead ratio of 0.90, and the older child scenario, using the 2.2 ug/dl baseline blood lead level cited above. The adult and fetal projections are based on typical national baseline blood lead levels for rural white, non-Hispanic female populations (i.e. mean baseline blood lead levels of 1.7 for adults with a GSD of 1.89). (Brody DJ, Pirlke JL, Kramer RA, Flegal KM, Matte TD, Gunter EW and Paschal DC (1994) Blood lead levels in the US population, JAMA, 272:277-283.) The baseline blood lead level for children is 2.2, resulting from combining baselines of 2.4 and 2.1 ug/dl for children ages 6-11 and 12-19 years (Brody et al , 1994).

Fetal blood lead projections are provided for purposes of comparison to adult concentrations. Fetal blood lead estimates differ from the mother due to the application of the fetal:maternal ratio as described in *Recommendations of the Technical Review Workgroup for Lead for an Interim Approach to Assessing Risks Associated with Adult Exposures to Lead in Soil* (U.S. EPA, 1996).

The population of interest includes both residents in the Coeur d'Alene river basin as well as people residing outside of this area who might visit the proposed trail. The U.S. EPA interim methodology requires use of baseline blood lead concentrations which reflect no site related exposures. In other words, for the population of interest, baseline blood lead concentrations that would occur if there were no exposure to contaminants in the Coeur d'Alene river basin are needed in order to estimate the potential effect of exposures to contaminants from the proposed response actions and subsequent trail use. The most desirable database would be from a population in Northern Idaho with characteristics identical to the Coeur d'Alene river basin population except for where they live. Because such a database does not exist, the best available surrogate is the NHANES III Phase 1 database.

0.6.4 Discussion

Carcinogenic risk: Pre-response Action Risks: Only arsenic is evaluated for carcinogenic risk. The results in Tables 5a-f show that the incremental child and adult recreational risk for cancer over a lifetime due to arsenic ingestion for typical BHSS and Modified Trail scenarios exceeds 1×10^{-4} prior to implementation of the proposed response action. *Child and adult recreational risks from Table 5 have been combined (or added) for the following discussion.* Prior to

implementation of the response action, maximum total carcinogenic risk for combined child and adult recreational exposures are 3.7×10^{-4} and 5.9×10^{-4} for the BHSS and Modified Trail scenarios, respectively. Occupational risks are about an order of magnitude higher, ranging to 2.3×10^{-3} . RME adult recreational risks are also an order of magnitude higher at 1.1×10^{-3} and the RME occupational risk is slightly higher at 5.1×10^{-3} . All maximum risk levels occur in the Big Creek to the BHSS or Elizabeth Park segment where the characteristic arsenic soil concentration is 6600 mg/kg.

Post-response Action Risks: These risks are decreased substantially following the proposed response action. Maximum post-response action combined child and adult carcinogenic risks are 8.5×10^{-6} and 1.3×10^{-5} for the BHSS and Modified Trail recreational scenarios, respectively, and 5.3×10^{-5} for the occupational exposure. The post-removal RME risks are 2.4×10^{-5} and 1.2×10^{-4} for the adult recreational and occupational scenarios, respectively. These values should be evaluated in the context of the post-response action clean soil assumption of 100 mg/kg arsenic, which results in incremental risks of 5.6×10^{-6} and 3.5×10^{-5} for the BHSS combined child and adult recreational and occupational scenarios, respectively. For the Modified Trail scenario shown in Table 5e, the clean soil criteria risks are 8.7×10^{-6} and 3.5×10^{-5} . The RME risk for the 100 mg/kg arsenic clean soil level is 1.6×10^{-5} for the adult recreational and 7.7×10^{-5} for the occupational exposures. For typical recreational and occupational scenarios, only the portion of the trail immediately downstream of the BHSS shows risk levels exceeding the clean soil criteria. The average and maximum arsenic concentration in the segment BHSS to Cataldo, following the response action, are 56 mg/kg and 152 mg/kg, respectively.

Non-carcinogenic risk: Hazard Quotients for arsenic, cadmium and zinc: HQs calculated for the typical recreational scenarios indicate insignificant risk (i.e. < 0.1) from non-carcinogenic effects for cadmium and zinc for all segments for both pre- and post-removal scenarios. For the pre-response action RME conditions, occupational scenario zinc and cadmium HQs exceed the 0.1 screening criteria above the BHSS site. Adult recreational zinc and cadmium HQs in the Big Creek to BHSS segment also exceed the 0.1 value. No post-response action cadmium or zinc HQs exceed a value of 0.1.

Pre- response action arsenic HQs for the BHSS and Modified Trail child recreational scenario exceed 0.1 from Wallace to the Coeur d' Alene Indian Reservation and from Wallace to Cataldo for adult recreational scenarios. Several areas show levels exceeding 0.1 for the pre-response action recreational and occupational RME scenario. Post-response action arsenic HQs exceed 0.1 for the occupational scenario from Mullan to Harrison under both the BHSS and Modified Trail scenarios and for the entire ROW for the RME recreational and occupational scenarios. Only one section of the proposed trail has post-removal arsenic levels exceeding the BHSS clean soil criteria of 100 mg/kg arsenic. The 100 mg/kg arsenic concentration results in recreational and occupational RME HQs of 0.10 and 0.34, respectively.

Blood lead increments for recreational exposures: Potentially significant blood lead increases are predicted for the entire ROW under the No-action scenario for both the BHSS and the Modified Trail assumptions. The blood lead levels predicted for the No-action alternatives have not been

observed in children or adults in the region. It is unlikely that the current railroad configuration would result in a recreational user experiencing the contact times and use rates assumed in the no-removal action analyses. Nevertheless, it is clear that the lead concentrations currently existing on the rail corridor present a hazard if contacted by children for a significant period of time.

Under the post-response action scenario, estimated blood lead increments are reduced to less than 0.5 ug/dl for persons accessing the trail under the recreational scenario in the residential portions of the proposed trail. However, in certain remote segments of the trail, recreational trail users are predicted to experience significant increases in blood lead levels. However, it is important to note that these predicted increases in blood lead levels are based on an assumption that the physical removal actions proposed in the EECA are implemented, but do not include the potentially beneficial blood lead effects resulting from implementation of the non-physical response actions, i.e., the institutional controls (warning signs, fences, obstructions, and educational programs) that are designed to limit access to and intake of contaminants. Based on these assumptions, increments of 1.7 ug/dl to >10 ug/dl are predicted for the Morning Mine to Woodland park segment, the segment from the BHSS to Cataldo, and the remote segment from Cataldo to Harrison. These increments result in 95th percentile blood lead levels exceeding 10 ug/dl.

Residential Risk: Residential exposures to soil lead in the ROW are unacceptably high in all of the residential communities under the No-action alternative. Soil lead concentrations ranging to greater than 10,000 mg/kg are dangerously high levels. In the BHSS, soils with lead levels exceeding 1000 mg/kg were scheduled for removal, with a Remedial Action Goal of 350 mg/kg as a community average. Clean soil criteria for the BHSS was established at 100 mg/kg lead and arsenic and 5 mg/kg cadmium (MFG, 1994). Analyses presented herein adopt the same BHSS clean soil criteria for the proposed response actions as were indicated for the residential areas within the BHSS. The proposed EECA response action includes the establishment of clean soil barriers throughout (and within 1000 feet) of all residences in the designated residential communities along the trail route. Assuming this distance encompasses the areas of typical residential activities of pre-school children, this action would resolve excessive residential exposures for young children and pregnant women associated with the ROW. Lead exposures in the ROW residential areas are reduced by more than 95%, to acceptable levels, by the proposed engineering actions. The estimated post-response action levels present little risk, will reduce overall exposure to lead in the communities, and are consistent with criteria likely to be adopted as a result of the overall Basin RI/FS.

Recreational Risk: Recreational scenario risk resulting from lead absorption is evaluated by the RME or 95th percentile blood lead estimate. Excessive recreational exposures (i.e. 95th percentile blood lead levels > 10 ug/dl) occur under the No-action alternative at several locations outside of the designated residential areas. Following implementation of the proposed physical response actions, excessive exposures are projected at particular remote segments of the trail. Increased carcinogenic risk is indicated in the segment from the BHSS to Cataldo where the maximum arsenic concentrations used in the risk calculations are 150% of the BHSS clean soil criteria. Average concentrations in the BHSS to Cataldo segment are about 50% of the BHSS clean soil criteria. Excessive lead absorption resulting in elevated blood lead levels in children could occur

in this segment, as well as in the Morning Mine to Woodland Park area and in the lower basin from the BHSS site to Harrison. The segment from Cataldo to Rose Lake is of particular concern in the absence of institutional controls to manage risks, due to the proximity of contaminated beaches and river front areas that are easily accessible and inviting to recreational uses.

Occupational Risk: With regard to occupational exposures occurring after implementation of the physical response actions, there are concerns with potential cancer and non-carcinogenic risks associated with ingested arsenic, and with sub-chronic risks to pregnant workers associated with potential lead exposures. These evaluations were made with respect to both No-action and post-response action scenarios. In addition, workers engaged in maintenance activities that involve breaking barriers or repairing re-contaminated areas could experience other exposures, potentially as great as pre-removal conditions.

Uncertainty in Arsenic, Cadmium and Zinc Risk Estimates: Each of the parameters and assumptions made in the risk analyses has some associated degree of uncertainty. The likelihood of the assumptions made regarding each parameter should be considered in assessing the results of the risk calculations. For many of the parameters, typical values have evolved and been developed from other studies and guidance and have been broadly applied in similar risk assessments. Other parameters are more site-specific in nature and subject to greater range of uncertainty. In such situations, sensitivity analyses are often conducted to identify those parameters that are most sensitive in outcome risk estimates. Sensitivity analyses may be quantitative and project ranges and probability estimates for varying input parameters and results. Semi-quantitative or qualitative sensitivity analyses are also appropriate depending on the nature of the analyses and the use of the results. For this assessment the latter is sufficient.

With regard to the carcinogenic and non-carcinogenic estimates for metals other than lead, uncertainties are associated with estimated contaminant concentrations (C), ingestion rates (i.e. the Human Intake Factor(HIF)), exposure frequency and duration, (i.e. Time Partition Factor(TPF)), and absorption rates (i.e. AF).

Contaminant concentrations are developed in Attachment A and include all sampling results used in these analyses. Although considerable sampling has been conducted, the ROW is seventy-two miles long and was divided into thirteen segments for assessment. As a result, some segments are characterized by lesser numbers of samples and, in the case of some segments, for some metals there are no data. Additionally, many of the areas sampled clearly contain high levels of lead and are proposed for removal of contaminants and/or installation of protective barriers. As a result, it was considered unnecessary to further characterize these areas in consideration of the proposed response actions. The most significant segments to consider in this assessment are those at which contaminant removals or protective barriers are not proposed or where fencing to keep people away from remaining contamination is not planned. These areas are the North-South portions of the ROW in the remote tourist/recreation segments (the segments not designated as residential areas). Many of these areas are characterized by less than ten samples and per USEPA guidance are considered a sparse data set. As a result, maximum sample concentrations, rather than mean

or typical results were utilized in the analyses. Post-response action maximum concentrations are generally 2-3 times greater than average values and represent a margin of safety in these analyses.

Contaminant concentrations were consistent with existing knowledge of the area, and were confirmed as representative in subsequent sampling events. With regard to Post-removal concentrations in areas where contaminant removals will be conducted and protective barriers will be installed, little ambiguity exists as to concentrations that might be encountered. In such areas, that include residential areas, oases, rest areas and the Coeur d' Alene Tribal Reservation, clean materials criteria are the critical concentrations to consider. In remote areas, the center portion of the trail will be capped, the North-South portions of the ROW where no physical response action is implemented, will in many locations exhibit concentrations similar to adjacent lands reflective of mine waste deposition, from sources not addressed within this EECA.

Ingestion rates used in the analyses vary as a function of the scenario. The 100 mg/day soil base rate used with the BHSS and Modified Trail scenarios is a conventional value reflective of EPA guidance. This value is broadly applied in these types of analyses including the BHSS Non-populated Areas risk assessment. Other studies have utilized values generally ranging on the order of one-half to two times this value. Halving or doubling the carcinogenic and non-carcinogenic risk estimates would effect little difference in the evaluation of the results for this EECA. Similar arguments apply to body weight and averaging time. The RME ingestion rates are substantially larger and likely for only a small portion of the population.

Exposure frequency and duration are likely the most sensitive parameters for these risk estimates. The inherent uncertainty in these parameters was accounted for in the range of contact times assumed by assessing different scenarios. The BHSS and Modified Trail scenarios assume that children and adults spend approximately 10% and 25%, respectively, of their summer waking hours on the trail in the most contaminated portion of the particular segment. These are conservative values that likely overestimate contact time for any particular location. The RME scenario assumes a similar contact time but applies larger ingestion rates. Contact rates for adult recreation are greater than that for children and are also likely conservative values in the context of carcinogenic and non-carcinogenic risk evaluations.

Absorption rate uncertainty applies to arsenic in the ingestion scenarios and to arsenic, cadmium and zinc in the dermal route example calculations. Arsenic absorption rates are reported to vary widely according to site specific conditions. Generally values range from 20% to >80%. In the BHSS and Modified Trail scenarios, 100% absorption was assumed to be consistent with the BHSS Non-populated Areas risk assessment. That conservative assumption was made with regard to the smelter origin of arsenic at the BHSS. For the RME analysis, a value of 60% was used to reflect the mid-range of reported absorption rates per USEPA Region X guidance.

Overall, in consideration of the known sources of uncertainty, selection of parameter values for the collective scenarios likely provides a margin of safety in estimating potential risks to arsenic, cadmium and zinc associated with the proposed trail. Maximum concentrations, typical and

extreme ingestion rates, conservative (longer) contact times, and higher absorption rates have been incorporated into the analyses.

Uncertainty in Lead Risk Estimates: With respect to estimated blood lead absorption, the range of predictions reflected in the different models also captures the uncertainty inherent in the analyses. Mean, or arithmetic average soil lead concentrations were used as more sample results were available for lead, and a different RME approach is applied. For the BHSS and Modified Trail models, the same ingestion rates and exposure frequency and duration assumptions used for the other metals were applied. As a result the same uncertainty considerations apply. The USEPA Adult Model for lead assumes event-specific ingestion rates attributable to the trail. The most sensitive parameters in predicting blood lead increments among the models are ingestion rates, contact times and bioavailability or absorption factor. The most significant factors in projecting overall blood lead levels are the baseline blood lead level and geometric standard deviation.

A major difference in the BHSS and Modified Trail model projections is related to the differences in weekly contact time of 10 and 24 hours, respectively. These contact times effectively produce time-weighted average ingestion rates of, respectively, 10 mg/day and 25 mg/day of trail soils for the four month exposure period (the late Spring to early Fall months when people are most likely to engage in recreational activities). The EPA Adult model assumes 50 mg/day twice a week for five weeks or an average of 14 mg/day for the exposure period. The BHSS and Modified Trail models assume respective bioavailabilities, or absorption rates, of 20% and 30%. This contrasts with the 12% effective rate in the EPA Adult model. The higher values are included to reflect the younger age range considered and uncertainty with pregnant women's absorption rates. Both the Modified Trail and the EPA Adult models use a biokinetic slope factor of 0.4 µg/dl per µg/day, and the BHSS uses 0.34 µg/dl per µg/day. As a result, the BHSS and EPA Adult models produce similar results, with the Modified Trail model predicting greater blood lead increments. Because there is uncertainty in these input parameters, the range of predictions of these models is likely a fair representation of the potential incremental effects on blood lead levels under the proposed trail scenario.

The U.S. EPA interim methodology requires use of baseline blood lead concentrations which reflect no site-related exposures. The method is primarily used to assess risks to exposure to lead contaminated sites for people who do not otherwise have excessive lead exposures. However, some residents in the Coeur d'Alene river basin who may have exposures to lead from sources contamination at the proposed UPRR ROW trail may also have ongoing exposures to lead elsewhere in the river basin. The use of the NHANES III Phase 1 database may underestimate risk for people with baseline blood lead concentrations which are elevated due to other exposures.

A limited database of blood lead concentrations from volunteer adults residing in the Coeur d'Alene river basin is available. However, it is not known whether these data are representative of all potential users of or future workers on the proposed UPRR ROW trail. This uncertainty was the basis for deciding that use of these data in this assessment was inappropriate.

Examination of the predicted levels show that the results from all three models are unambiguous with respect to the assessment of risk and subsequent risk management decisions. Nearly all segments present unacceptable risk under the No-action scenario. Order of magnitude reductions in intake are required to achieve acceptable blood lead increments. These can be achieved by installing protective barriers meeting the clean soil criteria or by reducing contact times through implementation of institutional controls, such as access limitations and management techniques. In formulating risk management strategies for the proposed trail, the former physical response actions are employed in residential and high-contact recreational locations, and the latter institutional controls are applied in remote areas where barrier installation is precluded by terrain or flood potential.

Other conclusions could be drawn if order of magnitude changes were made in the scenarios' assumptions. Specifically, that would require dramatically different assumptions regarding trail use or contact times or in the bioavailability of the contaminants. Although there are significant differences in opinions regarding contact times, ingestion rates and contaminant bioavailability at mine-related hazardous waste sites, those issues are unlikely to be resolved in the context of this removal action. Similarly, a more quantitative assessment of uncertainties in the risk estimates would be of limited assistance in evaluating post-response action conditions and risk management strategies.

Section 0.7 Human Health Risk Management Strategy

There is little doubt that much of the rail corridor is severely contaminated from both ROW and non-ROW sources. Many of the adjoining properties from Mullan to Harrison are also contaminated from various origins, including fluvially deposited tailings. Without appropriate response actions and access restrictions, these properties will continue to represent excessive risk to sensitive sub-populations throughout this area. The railroad ROW and many of the areas that would be accessed as part of the proposed trail system are already being used for recreational purposes by the local population. There is evidence that excess absorption is occurring among local children in some portions of the Basin, and any opportunity to reduce exposures should be viewed favorably. Conversion, appropriate response actions, and responsible management of the ROW corridor as a trail offer the opportunity to reduce current exposures and to develop a unique regional asset that could support and enhance future reclamation and health risk reduction efforts in the Basin.

Contamination throughout the ROW and adjacent properties is extensive, and these areas are subject to significant potential recontamination from fluvially deposited tailings from non-ROW sources due to flood events. It is unlikely that a total cleanup of the corridor and the accessible adjacent areas could be accomplished in the context of a response action limited to the UPRR ROW. Potential exposures to contaminants in the railroad corridor and adjacent areas can be substantially reduced through selective removals, barrier installations, institutional controls, and prudent management of the proposed trail. Acquisition and responsible management of these properties by public entities can effect positive improvements in both current and future exposures to contaminants by persons who use the ROW.

The proposed physical and institutional control response actions and risk management strategy supportive of trail development have been devised to achieve appropriate exposure profiles for occupational and recreational use by removing or covering soils in high-contact areas and by minimizing contact times in other contaminated locations. This can be accomplished through a combination of the response actions in areas that will be accessed by sensitive population groups, *and* by institutional controls and management techniques employed to limit access to other contaminated areas.

This strategy requires that in developing risk management techniques, three basic populations must be considered - trail workers, local residents and trail visitors. In both cases, young children and pregnant women represent the most-susceptible sub-populations. However, in recreational settings, older children (i.e., 6 to 15 years old) are at particular risk due to their propensity to explore and engage in unsupervised, aggressive activities involving soil and sediment contact. Three general exposure reduction strategies are proposed: *Residential Exposure Management*, *Recreational Exposure Management*, and *Occupational Exposure Management*. The respective strategies are predominately more important in particular portions of the proposed trail. Residential exposure management predominates in the Silver Valley sections east of the Superfund site and near Cataldo. Recreational risk management is most important in the remote areas along the river channel from the Superfund boundary to Cataldo and through the Chain Lakes region to Harrison. Below Harrison, removal of ballast, which is the predominant source of contamination in this area, as requested by the Coeur d' Alene Tribe, should resolve lead-health related issues in that segment of the trail.

0.7.1 Residential Exposure Management

Two particular considerations are important with regard to the local population. These residents may already have elevated blood lead levels due to general exposure conditions in the Basin, and they are more likely to use the trail with a higher frequency than Basin visitors. As a result, their exposures on the trail should be less than those currently experienced in the residential environment. Potential residential area exposures related to the trail are resolved by the response actions in the residential areas. Combinations of response actions will be undertaken to provide clean soil or gravel barriers throughout and extending 1000 feet beyond all designated residential communities adjacent to the trail. These response actions are particularly important to pregnant women and young children as their exposure is more likely to occur in residential areas, trail heads, and oases. In the residential areas, these actions will result in reductions in arsenic exposure that range from 29% to 98%, reductions in cadmium exposure that range from 39% to 99%, and reductions in potential lead and zinc exposures that range from 18% to 99%.

0.7.2 Recreational Exposure Management

In order to resolve recreational exposure risks, the proposed oasis/signage/education strategy that is part of the planned institutional controls will need to substantially reduce potential contaminant contact times in the recreational segments of the trail. The required reduction is to 40% to 90% of that projected in the higher use rate scenarios, or to average contact times of less than 2 to 5

hours per week in specific non-remediated areas. Assessment of the trail environs in each of the segments with high concentrations of lead remaining after the proposed response shows that the required contact times are possible to achieve.

The Morning Mine to Woodland Park segment is generally located in steep terrain; the more contaminated areas are unattractive and difficult to access. Any rest areas or trail access points developed will be covered by clean gravel or protective soil barriers. In the segment between Osburn and the BHSS, the trail is located on the southern bank of the river. The Osburn to Shont/Big Creek segment is located on a small bench above the river. The functional width of the bench will be covered by a protective barrier as part of the response action and signs will be posted to discourage individuals from accessing the adjacent river channel below the bench in this segment where the principal contaminant source is found.

Metals concentrations are particularly high in the river sediments adjacent to and within the ROW west of Big Creek, ranging as high as 20,000 mg/kg lead and greater than 1000 mg/kg arsenic. The risk management strategy for this area is to place an asphalt cap over the central portion of the trail corridor, provide a clean barrier between the edges of the asphalt and adjacent fencing, and plant hostile vegetation and/or place large rocks to discourage visitors from leaving the trail. Appropriate signage should be provided to inform visitors of the hazard and to discourage stops in this stretch. The Day Park at Osburn, the Shont siding at Big Creek, and the Kellogg green-belt in the BHSS can provide safe and clean rest stops along this segment.

Downstream of the BHSS the river basin begins to broaden and some particularly attractive areas become accessible to site visitors. Expected activities could include exploring, wading, fishing, and swimming. Special efforts must be made to discourage stops and exploration in those polluted areas. An effective education and signage program will be required so that visitors can engage in these activities in a safe manner. It is also proposed that rest stops with bathroom and picnicking facilities be developed at the beginning and end of these stretches. These areas will be signed with warnings specific to the upcoming hazards and will encourage visitors to move through to the next clean rest stop facility at the other end of the stretch. Picnicking areas will be supplied with facilities and signs to encourage hand washing before eating. Clean Stop-and-View locations are also proposed for these interim stretches. These especially attractive but potentially hazardous stretches are:

- BHSS to Cataldo: The segment from the BHSS to Cataldo is generally above the contaminated river channel and most of the functional ROW width will be at low concentrations following the application of the response action. Visitors could be attracted to the beaches and river channel along this portion of the line. River sands and beaches in this reach are estimated to have several thousand mg/kg lead. The siding facilities at Enaville and Cataldo can serve as beginning and ending rest stops for this stretch. Two primitive rest stops will be developed in clean areas to provide a view stop and installation of signage to repeat warnings about river channel access are proposed. Visitors will be discouraged from accessing the river channel and will be provided with attractive picnic facilities to encourage use of clean areas.

- **Cataldo to Rose Lake:** The two to three mile portion of the trail on both sides of the Dudley siding is a special concern due to the natural beauty of the sandy beaches abutting the river. River sands on these beaches and sandy strips between the proposed trail and the river are extremely attractive to people of all ages, but average 4000 mg/kg to 8000 mg/kg lead. To discourage people from accessing this area by car, the siding at Dudley will not be developed as a trail head, and parking facilities will not be provided. A primitive rest stop oasis above the railroad right-of-way and flood plain east of Dudley is proposed to serve as a clean oasis at one end of this section, with a trail head facility at the Rose Lake siding as the other. Additionally, periodic small asphalt Stop-and-View picnic table and viewing bench areas will be developed above flood stage elevations for rest stops in this area; these may attract boater use. This area will have to be heavily signed to keep young children out of the river sands.
- **Lane:** A major rest stop accessible from the State Highway is proposed for the Lane siding. Associated toilet and picnic facilities will be provided and the rest area will be clearly signed to encourage visitors to remain on the trail until Medimont. Primitive access to the Rainy Hill campground and the boating access east of Medimont will be developed across the adjacent peninsulas, if feasible, as interim stopping points.
- **Medimont to Springston:** Medimont will serve as a major clean rest stop prior to accessing another attractive section of rail-line to the west. Picnic tables and benches will be provided and toilet facilities will be developed or provided by agreement with local concessionaires. The western oasis for this section is proposed for Springston, with an intermediate Stop-and-View rest location at the entrance to Black Lake. At Springston it is proposed that only a small gravel parking lot at the bridge-head and a primitive rest stop at the old siding a quarter to one-half mile to the north be developed. No rest or view stops are proposed from Springston to Harrison, although several fishing access points are located in this stretch.
- **Harrison to Heyburn State Park to Plummer:** From Harrison to Plummer contaminated ballast (the primary source of contamination) will be removed. This action should resolve metals and mine waste related hazards in this section of the proposed trail.

0.7.3 Occupational Exposure Management

Excessive occupational exposures can be minimized and resolved through appropriate training and monitoring of personnel employed in trail maintenance and operations. Such training is routinely provided for workers and contractors employed in soil and dust related construction activities within the BHSS. This training is available through private vendors that provide periodic classes for a modest fee, or through the local health department under the auspices of the BHSS Site Institutional Controls Program.

Section 0.8 References

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